

Experimental Study on Skin Temperature of People in Office Activities at different Air Temperatures

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Abstract. The present study aims to understand the effect of skin temperature on the preferred air temperature in an office environment. Fifteen subjects chose the preferred air temperature in a climate chamber. There are five air temperature was chose which is 19, 21, 23, 26 and 29 °C and was exposed in the climate chamber. The study found that air temperature ranges between 19 °C - 29 °C and different metabolic rate give a difference skin temperature level that indicates the level of comfort by subjects. Analysis of skin temperature showed that levels of temperatures vary, depending on the BMI considered and the subject.

Introduction

In office buildings, energy consumption is not the only priority for indoor climate design. Attentions are increasingly drawn to the human and work environment interaction [1]. A healthy and effective built environment was proposed in the domain of green ergonomics [2]. Fisk and Rosenfeld [3] estimated that improved indoor environment can bring a direct increase in productivity, ranging between 0.5% and 5%. Proper thermal condition [4-6] and indoor air quality [7-10] have proved to be great help for better performance. An important goal in thermal comfort research is an enhanced understanding of the relationship between the human body and the surrounding environment. In this paper an approach to investigate the effect of skin temperature to air temperature various in an office environment with three type office activities.

Experimental Set up

All 15 subjects were using in this study to measure skin temperature while doing multitask in the chamber (Figure 1) (represent office room). There are three tasks the subjects must follow such as relaxing while sitting, typing or writing and printing paperwork as shown as in Table 1.

Table 1. Types of the task with the metabolic rate.

No. of Task	Types of the task	Metabolic rate (Met)
1	Thinking	1.0
2	Sitting while typing	1.2
3	Printing	1.6

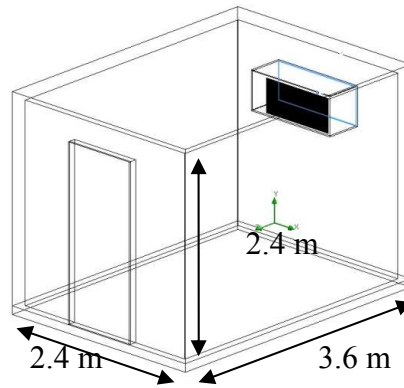


Fig 1, Environmental chamber: Layout of the environmental chamber

Results and Discussion

To calculate an average body skin temperature of subjects, the 11 collected skin temperatures from the head to ankle are simply averaged for mean level. The average skin temperature normally shows the highest level at 1.6 Met and the lowest at 1.0 Met as illustrated in Figure 2-6. Figure 2 shows the skin temperature with three activities at room temperature 19 °C. Since the temperature is significantly lower than the standby room, the skin temperature decreases as the subjects stays longer because they lose their body heat to the environment and the performed activity levels are not high enough to compensate for the body heat loss. The average skin temperature also varies depending on individual physiology in similar thermal conditions. The range of skin temperatures across the subjects is between 32.76 °C and 33.09 °C depending on individual physiological characteristics and activity levels.

Figure 3 presented skin temperature with three activities at room temperature 21 °C. This graph shows the range of skin temperatures across the each of subjects is between 33.02 °C and 33.46 °C. The different of temperature between room temperature 19 °C and 21 °C are 0.37 °C. However, in Figure 4 illustrated skin temperature with three activities at room temperature 23 °C. The range of skin temperatures for each of subjects is between 33.25 °C and 33.86 °C. The lowest and highest for room temperature 19-23 °C for all subjects is subject L.

Figure 5 and 6 shows the skin temperature with three activities at room temperature 26 °C and 29 °C. These room temperatures is the category as a warm chamber. Typically, the average skin temperature increases slightly as the activity level increase. However, the pattern is consistent compared to the case of the room temperature at 19 °C and 21 °C. Much different between activity level 1.2 Met and 1.6 Met. The range of skin temperature across the subjects is between 34.22 °C and 34.89 °C depending on individual physiological characteristics and activity levels. This result shows the Female (subject L) is very uncomfortable in room temperature 21 °C, 23 °C, 26 °C and 29 °C. In the activity level at 1.6 Met, subject L higher than others.

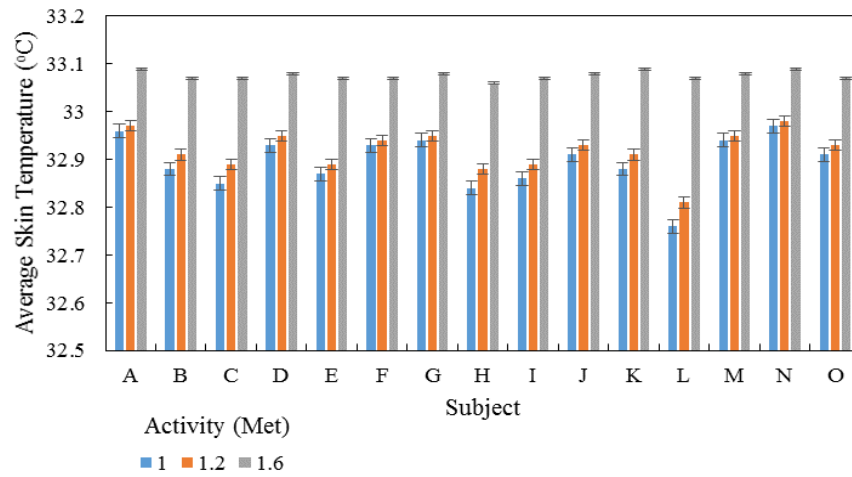


Fig. 2, Skin temperature with three activities at room temperature 19 °C

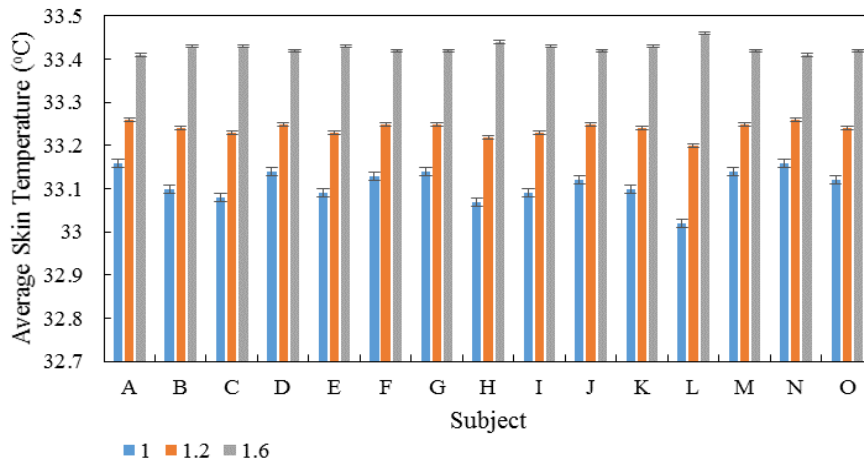


Fig. 3, Skin temperature with three activities at room temperature 21 °C

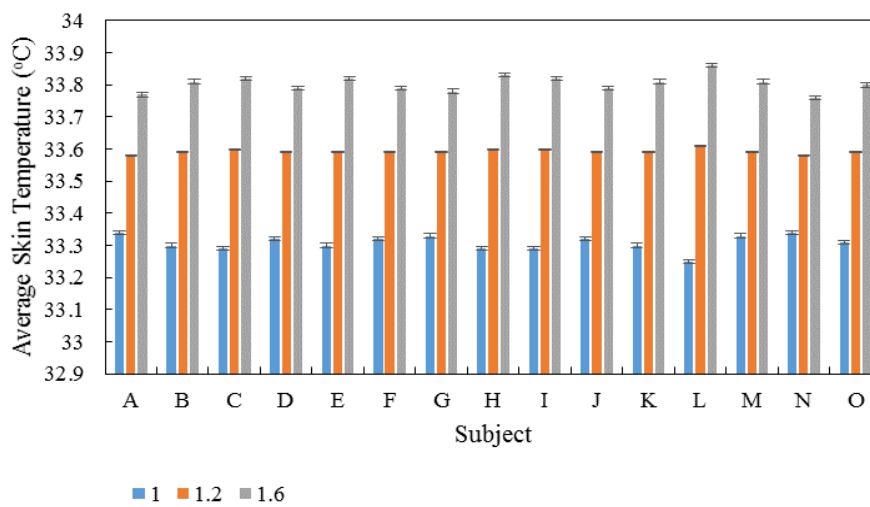


Fig. 4, Skin temperature with three activities at room temperature 23 °C

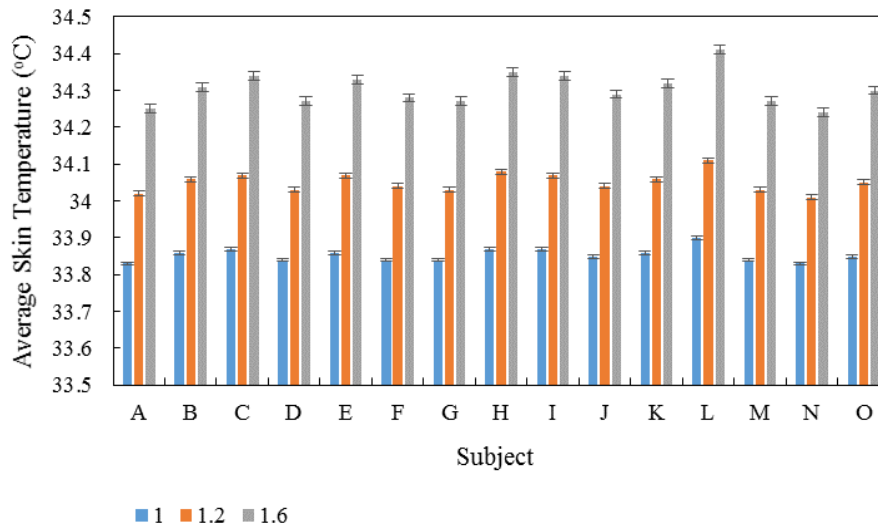


Fig. 5, Skin temperature with three activities at room temeperatute 26 °C

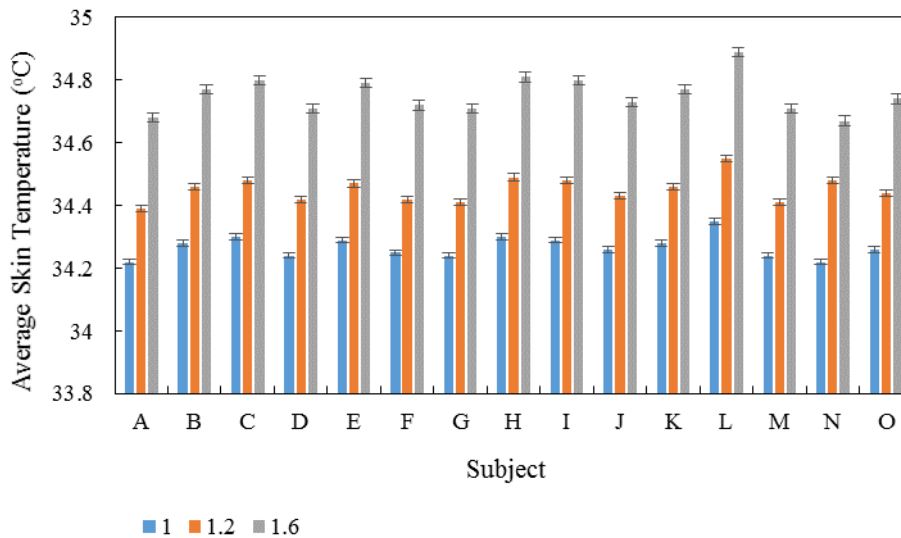


Fig. 6, Skin temperature with three activities at room temeperatute 29 °C

Summary

The study found that air temperature ranges between 19 °C - 29 °C and different metabolic rate give a difference skin temperature level that indicates the level of comfort by subjects. Analysis of skin temperature showed that levels of temperatures vary, depending on the BMI considered and the subject. The future studies on the effects of thermal environment on human body (another physiological response) should be consider using tests providing continuous feedback on performance.

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